Enhanced OS-9 for the GraphicsClient Board Guide

Version 1.2

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This manual reflects version 1.2 of Enhanced OS-9 for StrongARM.

Revision:	C
Publication date:	April 2000

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Chapter 1: Installing and Configuring Enhanced OS-9 for StrongARM

This chapter describes installing and configuring Enhanced OS-9 on the ADS SA-1100 Microprocessor Reference Platform (GraphicsClient). Before you begin, verify that the following actions have been performed:

- You successfully installed the ***Enhanced OS-9 for StrongARM*** CD-ROM onto your host PC.
- You are familiar with your board's features and capabilities.
- You have followed the start-up procedure for your SA-1100 evaluation board as stated in the ***Graphics Client User's Manual***.

This chapter includes the following sections:

For More Information

The ***Graphics Client User's Manual*** is provided by Applied Data Systems, Inc. (ADS document #100110-40025). You can download a copy of this document from www.flatpanels.com.

Note

These procedures can be performed with other StrongARM reference platforms. You will need to modify the procedures as necessary for your particular target platform.

Requirements and Compatibility

Host Hardware Requirements (PC Compatible)

Your host PC should have the following:

- Windows 95, Windows 98, or Windows NT
- A minimum of 32MB of free disk space (an additional 235MB of free disk space is required to run PersonalJava Solution for OS-9)
- An Ethernet network card
- A PCMCIA card reader/writer
- At least 16MB of RAM

Note

If you are a PersonalJava Solution for OS-9 licensee and you plan to use the Java JCC to pre-load your Java classes, you may need as much as 64MB of RAM. Refer to the document ***Using JavaCodeCompact*** for a complete discussion of using the JCC.

Host Software Requirements (PC Compatible)

Your host PC should have a terminal emulation program (such as `Hyperterminal` that comes with Microsoft Windows 95, Windows 98, and Windows NT).

Target Hardware Requirements

Your reference board requires the following hardware:

- Enclosure or chassis with power supply
- A RS-232 null modem serial cable
- LCD screen, keyboard, and mouse (for use with mwMAUI)

Java Hardware Requirements

Your reference board must have the following to run PersonalJava Solution for OS-9:

- 16MB of RAM
- 4MB of FLASH (Boot)
- LCD Display

OS-9 for StrongARM Architecture

The source and example code and makefiles for Enhanced OS-9 for StrongARM are located in the following directory. The directory structure is shown in **Figure 1-1**.

```
\mwos\OS9000\ARMV4\PORTS\GRAPHICSCLIENT\
```

Figure 1-1 OS-9 for StrongARM Directories

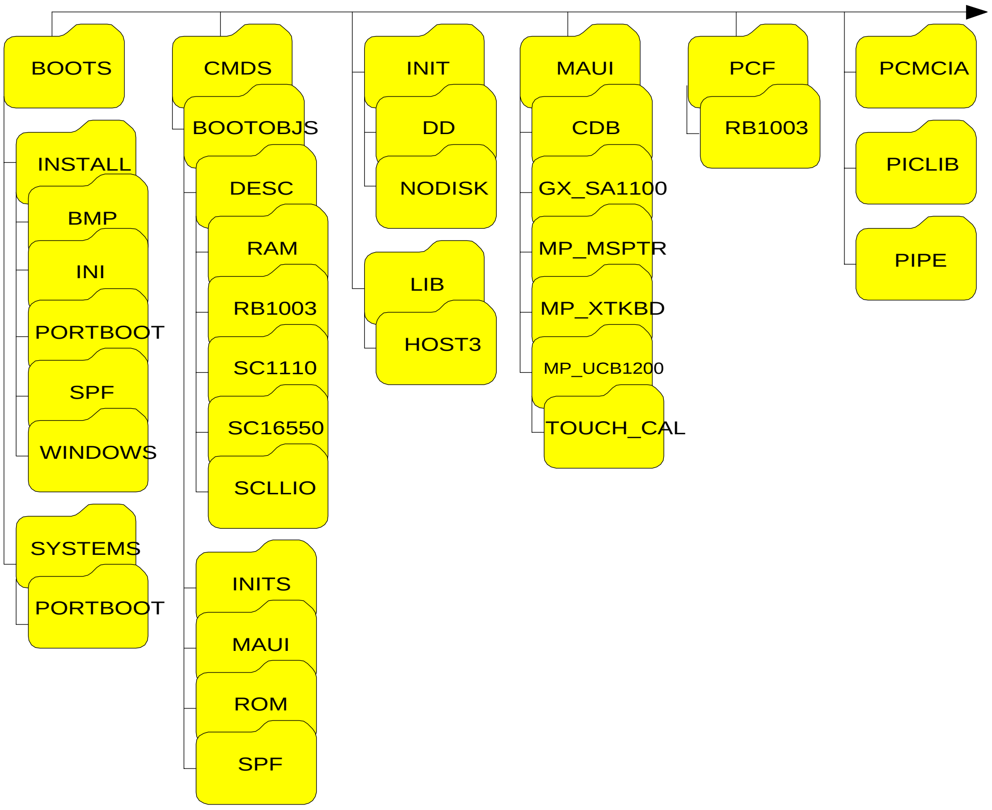
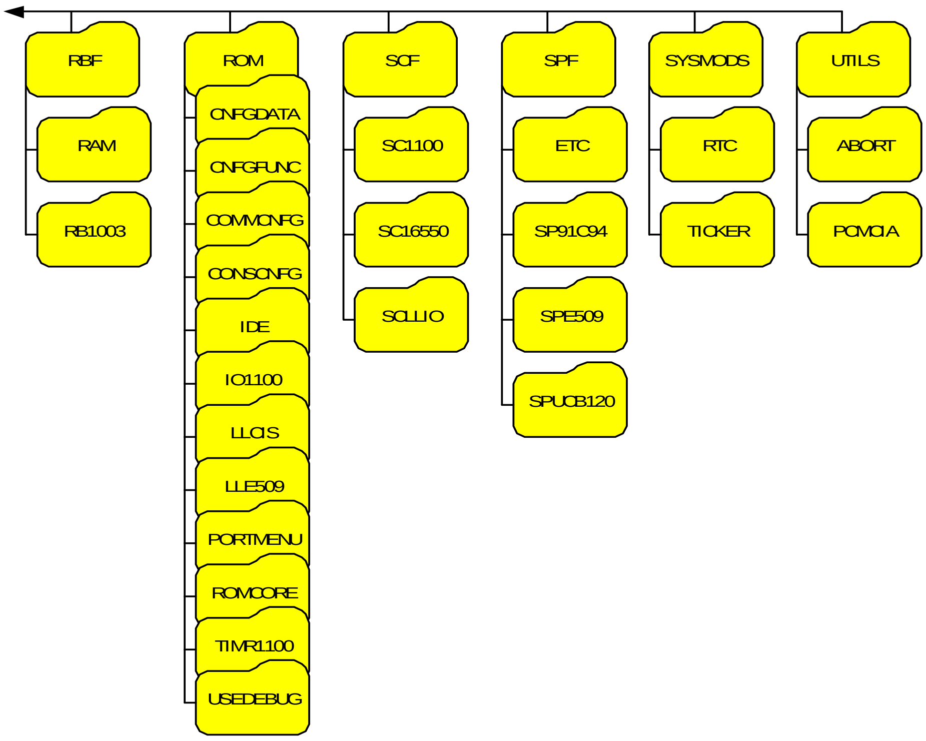


Figure 1-1 OS-9 for StrongARM Directories (continued)



Configure Board Switch Settings

Set the jumpers according to the ***GraphicsClient User’s Manual*** supplied by Applied Data Systems (ADS document # 100110-40025).

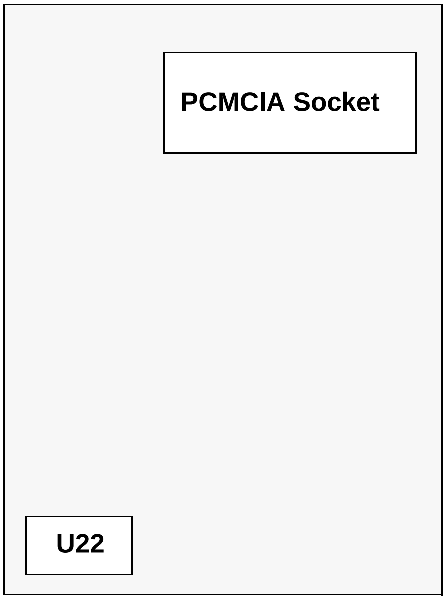
Note

In most cases you can use the default factory jumper settings.

Installing the Flash Device

The first stage in configuring your reference board is to install the pre-loaded FLASH device included in your Enhanced OS-9 for StrongARM package. This device includes a coreboot system that has been pre-configured to get your board up and running quickly. Install the FLASH device in socket U22.

Figure 1-2 Installing the Flash Devices



Note

If you need to reprogram the flash devices or create new flash devices, see the **Creating a new OS-9 Coreboot Image in Flash Memory (Optional)** section.

Connecting the Reference Board to the Host

Connect an RS-232 null modem cable from the reference board to the serial port of a Windows 95, Windows 98, or Windows NT system.

Step 1. Connect the serial cable to the J10 connector (or the DB9 connector that connects to J10) on the reference board. The J10 connector is the SA1100 serial port 3 (SP3).

Step 2. Connect the other end of the serial cable to the Host PC.

Step 3. On the Windows desktop, click on the `Start` button and select `Programs -> Accessories -> Hyperterminal`.

Step 4. Click the `Hypertrm` icon and enter a name for your Hyperterminal session.

Step 5. Select an icon for the new Hyperterminal session. A new icon is created with the name of your session associated with it. The next time you want to establish the same session, follow the directions in Step 3 and look for the icon you created in Step 4.

Step 6. Click `OK`

Step 7. In the **Phone Number** dialog, go to the **Connect Using** box, and select the communications port to be used to connect to the reference board.

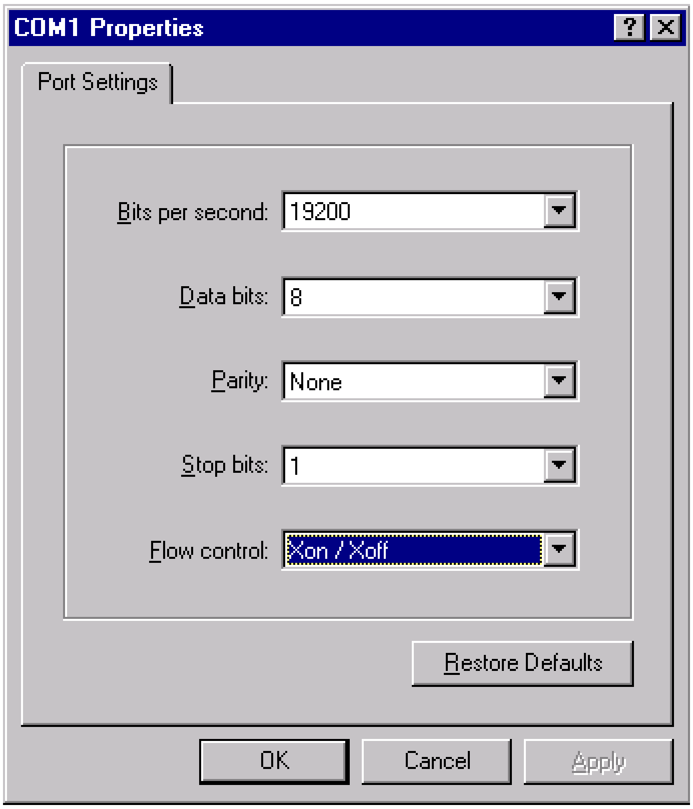
The port selected is the same port that you connected to the serial cable from the reference board.

Step 8. Click `OK`

Step 9. In the **Port Settings** tab, enter the following settings:

```
Bits per second = 19200

Data Bits = 8

Parity = None

Stop bits = 1

Flow control = XOn/XOff
```

Figure 1-3 Port Settings


COM1 Properties

Port Settings

Bits per second: 19200

Data bits: 8

Parity: None

Stop bits: 1

Flow control: Xon / Xoff

Step 10. Click `OK.`

Step 11. Go to the Hyperterminal menu and select `Call -> Connect` from the pull-down menu to establish your terminal session with the reference board. If you are connected, the bottom left of your Hyperterminal screen will display the word *connected*.

Step 12. Turn on the reference board. The OS-9 bootstrap message is displayed.

Configuring the ATA Card

You can use your ATA card to validate that your reference board is operational without requiring the connection to the host machine:

To configure the ATA card:

Step 1. From a DOS prompt on the host machine, navigate to the following directory:

```
MWOS\OS9000\ARMV4\PORTS\GRAPHICSCLIENT\BOOTS\SYSTEMS\PORTBOOT
```

and run `os9make`.

Step 2. On the host machine, copy the files located in the following directory:

```
MWOS\OS9000\ARMV4\PORTS\GRAPHICSCLIENT\BOOTS\SYSTEMS\PORTBOOT\os9kboot
```

into the root directory to the ATA card

Step 3. Install the card in the single PCMCIA socket on the reference board

Step 4. Turn on the reference board. After a few seconds an OS-9 shell prompt will appear on your terminal.

Creating and Configuring an OS-9 ROM Image

The OS-9 ROM image enables booting from PCMCIA IDE type cards. Use the Configuration Wizard to create an OS-9ROM Image to save in the root directory of the PCMCIA card. The Configuration Wizard was installed on your host PC during the Enhanced OS-9 for StrongARM installation process.

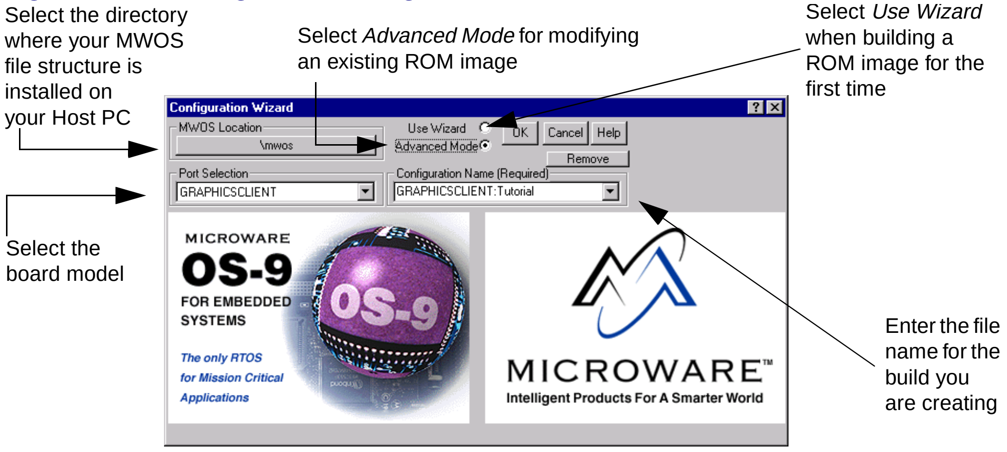
Note
Enhanced OS-9 for StrongARM also supports ATA Flash cards.

To use the Configuration Wizard, perform the following steps:

Step 1. Click the `Start` button on the Windows desktop.

Step 2. Select `Programs -> Enhanced OS-9 for StrongARM -> Microware Configuration Wizard`. You should see the following opening screen:

Figure 1-4 StrongARM Configuration Wizard


Select the directory where your MWOS file structure is installed on your Host PC
Select *Advanced Mode* for modifying an existing ROM image
Select *Use Wizard* when building a ROM image for the first time
Select the board model
Enter the file name for the build you are creating
Configuration Wizard
OK
Cancel
Help
Remove
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MWOS Location: \mwos
Use Wizard [✓ Advanced Mode]
Port Selection: GRAPHICSCLIENT
Configuration Name (Required): GRAPHICSCLIENT:Tutorial

Step 3. Select the path where the MWOS directory structure is located from the MWOS location button.

Step 4. Select the target board from the Port Selection pull-down menu.

Step 5. Name the ROM Image in the Configuration Name field.

Step 6. Select `Advanced Mode` and click `OK`. The Main Configuration window is displayed.

Step 7. Select `Configure -> Bootfile -> NetWork Configuration.`

Note

If you intend to use the Target board across a network, you need to configure the Ethernet settings. Be sure the Enable SoftStax radio button is selected in the SoftStax Setup tab.

Use the Configuration Wizard help for information on the settings.

Step 8. Leave the other options at the default settings.

Step 9. Select `Configure -> Build Image` to display the **Master Builder** screen.

Step 10. Click `Build`. This will build a boot image that can be placed on the PCMCIA card.

Step 11. Insert the PCMCIA IDE card into the PCMCIA slot of your computer.

Step 12. Click `Save As` to save the file `os9kboot` to the root directory of the PCMCIA IDE card.

Step 13. Turn off the power to the reference board.

WARNING

Inserting and removing a PCMCIA card with the power on is not supported in this release. Damage may occur to the PCMCIA card if it is inserted or removed while power is applied to the board.

Step 14. Remove the PCMCIA IDE card from the computer.

Step 15. Position the PCMCIA card so that the end with the connector holes is facing the PCMCIA socket and the label is facing up.

Step 16. Slide the card into the socket of the reference board until the card snaps onto the connector pins and the eject button pops out.

Note

The GraphicsClient design does not provide enough current for the TypeIII PCMCIA (double height).

Step 17. Apply power to the board. The reference board will boot from the IDE PCMCIA card and you should see the “$” prompt.

Connecting the Reference Board to an Ethernet Network (Optional)

Enhanced OS-9 for StrongARM supports using the onboard SMC91C94 or a 3COM Etherlink III - LAN PC Card for mwSoftStax TCP/IP connections. Also, Enhanced OS-9 for StrongARM provides system level support for telnet, FTP, and NFS.

To use Ethernet networking, you must create a bootfile that has the Ethernet options enabled and insert an Ethernet PCMCIA card into the reference board if you choose to use a PCMCIA Ethernet card.

Step 1. Click the `Start` button on the Windows desktop.

Step 2. Select `Programs -> Enhanced OS-9 StrongARM -> Microware Configuration Wizard`. You should see the opening screen.

Step 3. Click **OK**. The configuration screen is displayed.

Step 4. Select `Configure -> Bootfile -> NetWork Configuration`. The **network options** dialog box appears.

Step 5. Change the network settings as needed. See the Configuration Wizard help for more information on the network settings.

Step 6. Create a new Bootfile by following the directions in the **Creating and Configuring an OS-9 ROM Image** section.

Step 7. Turn off the power to the reference board.

WARNING
Inserting and removing a PCMCIA card with the power on is not supported in this release. Damage may occur to the PCMCIA card if it is inserted or removed while power is applied to the board.

Step 8. Position the PCMCIA IDE card so that the end with the PCMCIA female connector is facing PCMCIA socket and the label is facing up.

Slide the PCMCIA IDE card into the socket until the card snaps onto the pins and the eject button pops out.

Step 9. Connect the 10 Base T connector into J9 if using the onboard Ethernet.

or

Position the Ethernet PCMCIA card so that the end with the PCMCIA female connector is facing the PCMCIA socket and the label is facing up.

Slide the PCMCIA Ethernet card into the socket until the card snaps onto the pins and the eject button pops out.

Step 10. Restart your reference board.

Step 11. Test the Ethernet connection by pinging the reference board.

If the ping operation fails, you will have to check the following items:

- is the board connected to a live Ethernet port?
- is the Ethernet cable defective?
- are the network settings for the reference board correct?

Note

There is only one PCMCIA socket on the ADS Graphics Client board. In order to use the 3COM PCMCIA Ethernet card, you must first burn an Ethernet enabled OS-9 ROM image into the 16MB on-board Flash. See the **pflash** utility for more information.

Another option is to create a new EEPROM part with bootp, along with an appropriate server.

Pinging the Reference Board

Windows 95, Windows 98, and Windows NT include a Ping command that can be used to test the Ethernet connection for the reference board.

Step 1. Go to the DOS prompt.

Step 2. Type `ping <IP Address>`.

The IP Address is the address you assigned to the evaluation board in either the Coreboot module or the Bootfile module. The address is typed without the <> brackets.

If the ping was successful, you will see the following response:

```
Reply from <IP Address>: bytes=xx time =xms TTL= xx
```

If the ping was unsuccessful, you will see the following response:

```
Request timed out.
```

Creating a new OS-9 Coreboot Image in Flash Memory (Optional)

If you want to use ROM Ethernet services such as System State Debugging, you must create a new coreboot image. The coreboot image that was shipped with the reference board does not allow you to perform System State Debugging because the IP address in Flash ROM is set to “0.0.0.0”. You can create the coreboot image with an EPROM programmer.

Note

Re-creating the Coreboot image is required only when system state debugging is desired.

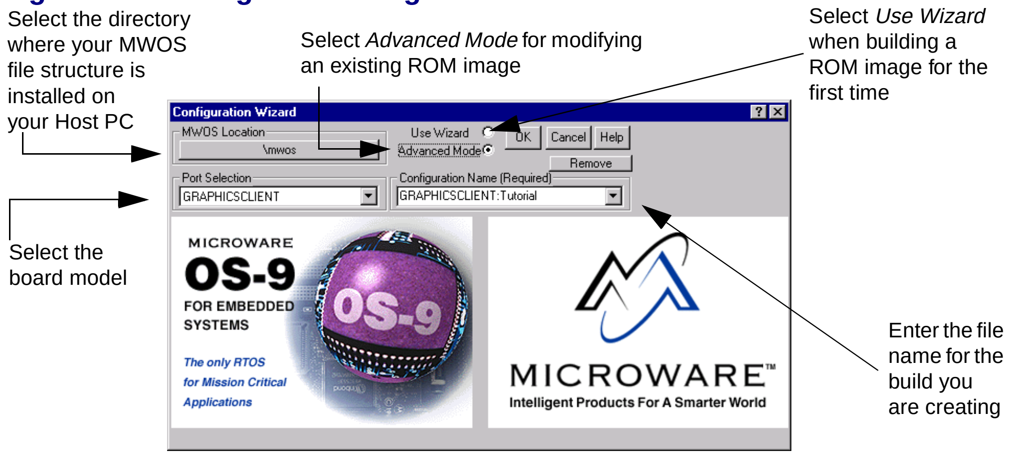
Making a Coreboot Image with an EPROM programmer

This section describes creating the Coreboot Image. When you are done creating the coreboot image, please refer to your EPROM programmer’s instructions to learn how to load the Coreboot image into the EPROM.

Step 1. Click the `Start` button on the Windows desktop.

Step 2. Select `Programs -> Enhanced OS-9 StrongARM -> Microware Configuration Wizard`. You should see the following opening screen:

Figure 1-5 StrongARM Configuration Wizard


Select the directory where your MWOS file structure is installed on your Host PC
Select *Advanced Mode* for modifying an existing ROM image
Select *Use Wizard* when building a ROM image for the first time
Select the board model
Enter the file name for the build you are creating
Configuration Wizard
OK
Cancel
Help
Remove
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MWOS Location: \mwos

Use Wizard [✓ Advanced Mode]

Port Selection: GRAPHICSCLIENT

Configuration Name (Required): GRAPHICSCLIENT:Tutorial

Step 3. Give the boot image a name in the **Configuration Name** field.

Step 4. Select `Advanced Mode` and click `OK`. The configuration screen is displayed.

Step 5. Make any necessary changes to the coreboot settings.

Step 6. Select `Configure->Build Image` to display the **Master Builder** screen.

Step 7. Select the `Coreboot Only Image` setting and click `Build`.

Step 8. Click `Save As` to save the coreboot image to a directory of your choosing. If you do not have that directory on the drive, you can create it.

Step 9. Transfer the coreboot image to the EPROM with the EPROM programmer. You will need to follow the documentation for the EPROM programmer to complete this step.

Chapter 2: Board Specific Considerations

This chapter contains information that is specific to the INTEL SA-1100 Microprocessor Reference Platform (GraphicsClient) reference board. It includes the following sections:

- **Low-Level System Modules**
- **Boot Options**
- **High-Level System Modules**
- **OS9 Vector Mappings**
- **GraphicsClient GPIO Usage**
- **Port Specific Utilities**
- **Memory Remapping**

For More Information

For general information on porting OS-9, see the ***OS-9 Porting Guide.***

Low-Level System Modules

For More Information

For a complete list of OS-9 modules common to all boards, see the ***OS-9 Device Descriptor and Configuration Module Reference*** manual.

The following low-level system modules are tailored specifically for the ADS SA1100 GraphicsClient platform. The functionality of these modules can be altered through changes to the configuration data module (`cnfgdata`). **Table 2-1** provides a list and brief description of the modules.

These modules can be found in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/ROM`

Table 2-1 GraphicsClient-Specific Low-Level System Modules

Module Name	Description
`cnfgdata`	Contains the low-level configuration data.
`cnfgfunc`	Provides access services to cnfgdata data.
`commcnfg`	Inits communication port defined in cnfgdata.
`conscnfg`	Inits console port defined in cnfgdata.
`ide`	IDE boot support module. PCMCIA compatible.
`io1100`	Provides polled serial driver support for the low-level system.

Table 2-1 GraphicsClient-Specific Low-Level System Modules

Module Name	Description
`llcis`	Inits the PCMCIA interface including cards.
`lle509`	Provides low-level ethernet services via 3COM PCMCIA card.
`portmenu`	Inits booters defined in the cnfgdata.
`romcore`	Board specific initialization code.
`splash`	Provides way to init LCD screen with a compressed image.
`tmr1_1100`	Provides low-level timer services via time base register.
`usedebug`	Inits low-level debug interface to RomBug, SNDP, or none.

The following low-level system modules provide generic services for OS9000 Modular ROM. Table 2-2 provides a list and brief description of the modules.

These modules can be found in the following directory:

```
MWOS/OS9000/ARMV3/CMDS/BOOTOBJS/ROM
```

Table 2-2 Generic Services Low-Level System Modules

Module Name	Description
`bootsys`	Booter registration service module.
`console`	Provides console services.

Table 2-2 Generic Services Low-Level System Modules (continued)

Module Name	Description
`dbgentry`	Inits debugger entry point for system use.
`dbgserve`	Provides debugger services.
`excption`	Provides low-level exception services.
`flshcach`	Provides low-level cache management services.
`hlproto`	Provides user level code access to protoman.
`llbootp`	Booter which provides bootp services.
`llip`	Provides low-level IP services.
`llslip`	Provides low-level SLIP services.
`lltcp`	Provides low-level TCP services.
`lludp`	Provides low-level UDP services.
`llkermit`	Booter which uses kermit protocol.
`notify`	Provides state change information for use with LL and HL drivers.
`override`	Booter which allows choice between menu and auto booters.
`parser`	Provides argument parsing services.
`pcman`	Booter which reads MS-DOS file system.
`protoman`	Protocol management module.

Table 2-2 Generic Services Low-Level System Modules (continued)

Module Name	Description
`restart`	Booter which cause a soft reboot of system.
`romboot`	Booter which allows booting from ROM.
`rombreak`	Booter which calls the installed debugger.
`rombug`	Low-level system debugger.
`sndp`	Provides low-level system debug protocol.
`srecord`	Booter which accepts S-Records.
`swtimer`	Provides timer services via software loops.

Boot Options

Following are the default boot options for the reference board. You can select these by hitting the space bar when the Now Trying to Override Autobooters message appears on the console port when booting.

You can configure these booters by altering the `default.des` file at the following location:

```
MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/ROM
```

Booters can be configured to be either menu or auto booters. The auto booters automatically try and boot in order from each entry in the auto booter array. Menu booters from the defined menu booter array are chosen interactively from the console command line after getting the boot menu.

Booting from FLASH

When the `romcnfg.h` has a ROM search list defined the options `ro` and `lr` appear in the boot menu. If no search list is defined N/A appears in the boot menu. If an OS9 bootfile is programmed into flash in the address range defined in ports default.des file the system can boot and run from flash.

`ro`	rom boot—the system runs from the FLASH bank.
`lr`	load to ram—the system copies the flash image into ram and runs from there.

Booting from PCMCIA ATA Card

The system can boot from a PC formatted PCMCIA hard card which resides in the PCMCIA slot.

`ide0`	The file os9kboot is searched for in slot 0. If found it is copied to system RAM and runs from there.

Booting from PCMCIA Ethernet Card

The system can boot using the BootP protocol using an Ethernet card and `eb` option.

`eb`	Ethernet boot—a PCMCIA card which supports ethernet will use the bootp protocol to transfer in a bootfile into RAM and the systems runs from there.

Booting over Serial Communications Port via kermit

The system can down-load a bootfile in binary form over its serial communication port at 115200 using the kermit protocol. The speed of this transfer depends of the size of the bootfile, but expect at least a 3 minute wait, dots will show the progress of the boot. The communications port is located at header J7 and uses the SA1100's SP1 UART.

`ker`	kermit boot—The os9kboot file is sent via the kermit protocol into system RAM and runs from there.

Restart Booter

The restart booter allows a way to restart the bootstrap sequence.

q	quit—quit and attempt to restart the booting process.

Break Booter

The break booter allows entry to the system level debugger (if one exists). If the debugger is not in the system the system will reset.

`break`	break—break and enter the system level debugger rombug.

Example boot session and message.

```
OS-9000 Bootstrap for the ARM

ATA IDE disk found in socket 00
Now trying to Override autobooters.

BOOTING PROCEDURES AVAILABLE ------------- <INPUT>

Boot embedded OS-9000 in-place ----------- <N/A>
Copy embedded OS-9000 to RAM and boot ---- <N/A>
Boot from PCMCIA-1 IDE ------------------- <ide1>
Boot from PCMCIA-0 IDE ------------------- <ide0>
Load bootfile via kermit Download -------- <ker>
Restart the System ----------------------- <q>
Enter system debugger -------------------- <break>

Select a boot method from the above menu: ide0


Wait for IDE drive ready.
IDE Model                  :       ATA_FLASH
Number Heads               : 0x0002
Total Cylinders            : 0x03d8
Sectors Per Track          : 0x0020

Checking Partitions        : 0
Fat Type                   : 0x16
File Name                  : OS9KBOOT
File Size                  : 0x000fdeb0
Start Cluster              : 0x00003a57
Reading Bootfile....

Boot Address               : 0xc002c850
Boot Size                  : 0x000fdeb0

OS-9000 kernel was found.
A valid OS-9000 bootfile was found.
$
```

High-Level System Modules

The following OS-9 system modules are tailored specifically for your Intel SA1100 GraphicsClient board and peripherals. Unless otherwise specified, each module is located in a file of the same name in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS`

CPU Support Modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/CMDS/BOOTOBJS`

`kernel`	The kernel provides all basic services for the OS-9 system.
`cache`	Provides cache control for the CPU cache hardware. The cache module is in the file `cach1100`.
`fpu`	Provides software emulation for floating point instructions.
`ssm`	The System Security Module provides support for the Memory Management Unit (MMU) on the CPU.
`vectors`	Provides interrupt service entry and exit code. The vectors module is found in the file `vect110`.

System Configuration Module

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/INITS`

`init`	Descriptor module with high level system initialization information.
`nodisk`	Same as init, but used in a disk-less system.

Interrupt Controller Support

This module provides extensions to the vectors module by mapping the single interrupt generated by an interrupt controller into a range of pseudo vectors which are recognized by OS-9 as extensions to the base CPU exception vectors.

For More Information

The mappings are described in the OS9 Vector Mappings section.

`irq1100`	P2module that provides interrupt acknowledge and dispatching support for the SA1100 pic.
`irqtc`	P2module that provides interrupt acknowledge and dispatching support for the GraphicsClient pic (vector range 0xB1-0xC0).

Real Time Clock

`rtc1100`	Driver that provides OS-9 access to the SA1100 on-board real time clock.

Ticker

`tk1100`	Driver that provides the system ticker based on the SA1100 Operating System Timer.

Abort Handler

`abort`	P2module which provides a way to enter the system-state debugger via the GPIO[0] interrupt triggered by GraphicsClient switch S1, 1.

Generic IO Support modules (File Managers)

These files are located in the following directory:

`MWOS/OS9000/ARMV3/CMDS/BOOTOBJS`

`ioman`	Provides generic io support for all IO device types.
`scf`	Provides generic character device management functions.
`rbf`	Provides generic block device management functions for OS-9 specific format.
`pcf`	Provides generic block device management functions for MS-DOS FAT format.
`spf`	Provides generic protocol device management function support.
`mfm`	Provides generic graphics device support for MAUI.
`pipeman`	Provides a memory FIFO buffer for communication.

Pipe Descriptor

This file is located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/DESC`

`pipe`	Pipeman descriptor that provides a RAM based FIFO which can be used for process communication.

RAM Disk Support

`ram`	RBF driver which provides a RAM based virtual block device.

Descriptors for Use with RAM

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/DESC/RAM`

`r0`	RBF descriptor which provides access to a ram disk.
`r0.dd`	Same as r0 except with module name dd (for use as the default device).

Serial and Console Devices

sc1100	SCF driver which provides serial support the SA1100's SP1 and SP3 ports when configured as UARTS.

Descriptors for Use with sc1100

`term1/t1`	Descriptor modules for use with sc1100 and SP1. GraphicsClient Board header: J7

	Default Baud Rate:	19200
	Default Parity:	None
	Default Data Bits:	8
	Default Handshake:	Software
`term3/t3`	Descriptor modules for use with sc1100 and SP3.	
	GraphicsClient Board header:	J2
	Default Baud Rate:	115200
	Default Parity:	None
	Default Data Bits:	8
	Default Handshake:	Software

`sc16550` SCF driver which provides serial supports a 16550 compatible modem card.

Descriptors for use with sc16550

`t0m`	Descriptor modules for use with the external PCMCIA card	
sc16550		
	GraphicsClient Board header:	J11 PCMCIA slot
	Default Baud Rate:	9600
	Default Parity:	None
	Default Data Bits:	8
	Default Handshake:	Software

Descriptors for Use with scllio

`vcons/term`	Descriptor modules for use with scllio in conjunction with a low-level serial driver. Port configuration and set up follows what is configured in cnfgdata for the console port. It is possible for scllio to communicate with a true low-level serial device driver like io1100, or with an emulated serial interface provided by iovcons. See the OEM manual for more information.

PCMCIA Support for IDE Type Devices

`rb1003`	RBF/PCF driver that provides driver support for IDE/EIDE devices. This driver is used to provide disk support for PCMCIA ATA FLASH.

Descriptors for Use with rb1003

`hc1/hc1fmt` and `hc1.dd`

RBF Descriptor modules for use\
 with PCMCIA slot #0

GraphicsClient Board header:J11

hc1fmt:	format enabled
hc1.dd:	module name of dd

`mhc1/mhc1.dd`

PCF Descriptor modules for use with PCMCIA slot #0

GraphicsClient Board header:J11

mhc1.dd:	module name of dd

PCMCIA Support for 3COM Ethernet card

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/SPF`

`spe509_pcm`	SPF driver to support ethernet for a 3COM EtherLink III PCMCIA card.

Descriptors for Use with spe509_pcm

`spe30`	SPF descriptor module for use with PCMCIA slot #0 (J11)

Network Configuration Modules

`inetdb/inetdb2/rpcdb`

SMC91C94 Ethernet Support

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/SPF`

`spe91c94`	SPF driver to support ethernet for the SMC91C94 chip.

Descriptor for Use with spe91c94

`spsm0`	SPF descriptor module for use with SMC91C94 at J9.

Network Configuration Modules

`inetdb/inetdb2/rpcdb`

UCB1200 Support modules.

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/SPF`

`spucb1200`	SPF driver that supports the on-board Phillips UCB1200 chip. This device communicates to the SA1100 over SP4 using MCP.

Descriptors for Use with spucb1200

`ucb`	SPF descriptor module that provides access to UCB1200.
`ucb_touch`	SPF descriptor module used with the touch screen.

Maui Graphical Support modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT/CMDS/BOOTOBJS/MAUI`

`gx_sa1100`	MFM MAUI driver module with support for the GraphicsClient LCD panel.

Descriptors for Use with gx_sa1100

`gfx`	MFM MAUI descriptor module for GraphicsClient LCD.
`sd_ucb 1200`	MFM MAUI driver module that provides PCM/mu-law sound support via the ucb1200.

Descriptors for Use with sd_ucb1200

`snd`	MFM MAUI descriptor module for UCB1200 sound functions.

MAUI configuration modules

`cdb`	MAUI configuration data base module.
`cdb_ptr`	Serial mouse configuration data base module.
`cdb_touch`	Touch screen configuration data base module.

MAUI protocol modules

`mp_kybrd`	Keyboard protocol module
`mp_msptr`	Serial mouse protocol module.
`mp_ucb1200`	ucb1200 protocol module.

For More Information

The MAUI drivers are described in more detail in Appendix B: MAUI Driver Descriptions.

OS9 Vector Mappings

This section contains the vector mappings for the OS9 GraphicsClient implementation of the SA1100.

The ARM standard defines exceptions 0x0-0x8. The OS-9 system maps these 1-1. External interrupts from vector 0x6 are expanded to the virtual vector rage shown below by the irq1100 module.

Note

Vectors can be virtually remapped from a ROM at physical address 0, into DRAM at virtual address 0. This speeds up interrupt response time and is enabled by defining the first cache list entry as a sub 1 Meg size.

For More Information

See the 1100 hardware documentation for more information on individual sources.

Table 2-3 and Table 2-4 show the OS9 IRQ assignment for the GraphicsClient SA1100 board.

Table 2-3 IRQ Assignments and ARM Functions

OS9 IRQ #	ARM Function
0x0	Processor Reset
0x1	Undefined Instruction
0x2	Software Interrupt

Table 2-3 IRQ Assignments and ARM Functions (continued)

OS9 IRQ #	ARM Function
0x3	Abort on Instruction Prefetch
0x4	Abort on Data Access
0x5	Unassigned/Reserved
0x6	External Interrupt
0x7	Fast Interrupt
0x8	Alignment error

Table 2-4 IRQ Assignments and SA1100 Specific Functions

OS9 IRQ #	SA1100 Specific Function (pic)
0x40	GPIO[0] Edge Detect (IRQ Input from GraphicsClient PIC.)
0x41	GPIO[1] Edge Detect
0x42	GPIO[2] Edge Detect
0x43	GPIO[3] Edge Detect
0x44	GPIO[4] Edge Detect
0x45	GPIO[5] Edge Detect
0x46	GPIO[6] Edge Detect

Table 2-4 IRQ Assignments and SA1100 Specific Functions (continued)

OS9 IRQ #	SA1100 Specific Function (pic)
0x47	GPIO[7] Edge Detect
0x48	GPIO[8] Edge Detect
0x49	GPIO[9] Edge Detect
0x4a	GPIO[10] Edge Detect
0x4b	OR of GPIO edge detects 27 - 11
0x4c	LCD controller service request
0x4d	UDC service request (0)
0x4e	SDLC service request (1a)
0x4f	UART service request (1b) (SP1)
0x50	UART/HSSP service request (2)
0x51	UART service request (3) (SP3)
0x52	MCP service request (4a)
0x53	SSP service request (4b)
0x54	DMA controller channel 0
0x55	DMA controller channel 1
0x56	DMA controller channel 2
0x57	DMA controller channel 3

Table 2-4 IRQ Assignments and SA1100 Specific Functions (continued)

OS9 IRQ #	SA1100 Specific Function (pic)
0x58	DMA controller channel 4
0x59	DMA controller channel 5
0x5a	OS timer 0
0x5b	OS timer 1
0x5c	OS timer 2
0x5d	OS timer 3
0x5e	One Hz clock tick
0x5f	RTC als alarm register
0x60	GPIO[11] Edge Detect (the vector 0x4b OR is broken out here to make each one distinct)
0x61	GPIO[12] Edge Detect
0x62	GPIO[13] Edge Detect
0x63	GPIO[14] Edge Detect
0x64	GPIO[15] Edge Detect
0x65	GPIO[16] Edge Detect
0x66	GPIO[17] Edge Detect
0x67	GPIO[18] Edge Detect
0x68	GPIO[19] Edge Detect

Table 2-4 IRQ Assignments and SA1100 Specific Functions (continued)

OS9 IRQ #	SA1100 Specific Function (pic)
0x69	GPIO[20] Edge Detect
0x6a	GPIO[21] Edge Detect
0x6b	GPIO[22] Edge Detect
0x6c	GPIO[23] Edge Detect
0x6d	GPIO[24] Edge Detect
0x6e	GPIO[25] Edge Detect
0x6f	GPIO[26] Edge Detect
0x70	GPIO[27] Edge Detect

Table 2-5 shows the GraphicsClient Pic functions.

Table 2-5 GraphicsClient Pic Functions

OS9 IRQ #	GraphicsClient Function (GraphicsClient Pic)
0xb1	RESERVED
0xb2	RESERVED
0xb3	RESERVED
0xb4	RESERVED
0xb5	RESERVED
0xb6	RESERVED

Table 2-5 GraphicsClient Pic Functions (continued)

OS9 IRQ #	GraphicsClient Function (GraphicsClient Pic)
0xb7	PCMCIA slot 0 Ready/IRQ
0xb8	RESERVED
0xb9	UCB 1200
0xba	SMC 91C94 Ethernet
0xbb	RESERVED
0xbc	PCMCIA Card A detect
0xbd	RESERVED
0xbe	Board Switch
0xbf	IRQ SSP
0xc0	IRQ BAT FAULT

Note

Fast Interrupt Vector (0x7)

The ARM4 defined fast interrupt (FIQ) mapped to vector 0x7 is handled differently by the OS-9 interrupt code and can not be used as freely as the external interrupt mapped to vector 0x6. To make fast interrupts as quick as possible for extremely time critical code, no context information is saved on exception and FIQs are never masked. This requires any exception handler to save and restore its necessary context if the FIQ mechanism is to be used. This requirement means that a FIQ handler's entry and exit points must be in assembly, as the C compiler will make assumptions about context. In addition, no system calls are possible unless a full C ABI context save has been done first. The OS-9 IRQ code for the SA1100 has assigned all interrupts as normal external interrupts and the user must re-define a source as an FIQ to make use of this feature.

GraphicsClient GPIO Usage

Table 2-6 shows GPIO usage of the GraphicsClient board in an OS9 system.

For More Information

See the ADS ***Graphics Client User's Manual*** for available alternate pin functions.

Table 2-6 GPIO Usage of the GraphicsClient Board

GPIO	Signal Name	Direct	Description
GPIO0	`/IRQ`	Input	Falling edge interrupt from external peripheral
GPIO1	`SWITCH`	Input	External signal to wake processor up during sleep mode.
GPIO2	`GREEN3`	Output	LCD Green bit 3 in 16 bit color mode=20
GPIO3	`GREEN4`	Output	LCD Green bit 4 in 16 bit color mode
GPIO4	`GREEN5`	Output	LCD Green bit 5 in 16 bit color mode
GPIO5	`RED0`	Output	LCD Red bit 0 in 16 bit color mode

Table 2-6 GPIO Usage of the GraphicsClient Board (continued)

GPIO	Signal Name	Direct	Description
GPIO6	`RED1`	Output	LCD Red bit 1 in 16 bit color mode
GPIO7	`RED2`	Output	LCD Red bit 2 in 16 bit color mode
GPIO8	`RED3`	Output	LCD Red bit 3 in 16 bit color mode
GPIO9	`RED4`	Output	LCD Red bit 4 in 16 bit color mode
GPIO10	`SSP_TXD`	Output	SSP Port transmit
GPIO11	`SSP_RXD`	Input	SSP Port Receive
GPIO12	`SSP_SCLK`	Output	SSP Port Clock
GPIO13	`SSP_SFRM`	Output	SSP Port Frame
GPIO14	`CTS1`	Input	CTS SA1100 uart 1 (not needed)
GPIO15	`RTS1`	Output	RTS SA1100 uart 1 (not needed)
GPIO16	`CTS2`	Input	CTS SA1100 uart 2 (not needed)
GPIO17	`RTS2`	Output	RTS SA1100 uart 2 (not needed)
GPIO18	`CTS3`	Input	CTS SA1100 uart 3 (not needed)

Table 2-6 GPIO Usage of the GraphicsClient Board (continued)

GPIO	Signal Name	Direct	Description
GPIO19	`RTS3`	Output	RTS SA1100 uart 3 (not needed)
GPIO20	`LED0`	Output	SMD LED D3 on board
GPIO21	`LED1`	Output	SMD LED D2 on board
GPIO22	`LED2`	Output	SMD LED D1 on board
GPIO23	`IRDA ON`	Output	0 IRDA On, 1 IRDA Off
GPIO24	`LED4`	In/Out	External GPIO on J7, P38
GPIO25	`LED5`	In/Out	External GPIO on J7, P36
GPIO26	`LED6`	In/Out	External GPIO on J7, P34
GPIO27	`LED7`	In/Out	External GPIO on J7, P32

GPIO Interrupt Polarity

When GPIO’s are used as interrupt sources, the _pic_enable() function will set default polarity to rising edge (GRER) along with enabling the interrupt at the SA1100 PIC. If falling edge is required, software must assert the appropriate bit in the GFER and negate the corresponding bit in the GRER.

Port Specific Utilities

The following port specific utilities are included:

- `pcmcia`
- `pflash`
- `touch_cal`
- `ucbtouch`

`pcmcia`

Syntax

```
pcmcia [<opts>]
```

options

`-s=`	socket: socket [default all sockets]
`-d`	de-iniz socket(s)
`-i`	iniz socket(s)
`-v`	verbose mode
`-x`	dump CIS/Config information
`-?`	Print this help message

Description

`pcmcia` provides the ability to initilize or deinitilize a PCMCIA card after the system has booted. It also displays a PCMCIA cards CIS structure.

Example

```
$ pcmcia -x -s=0
ATA IDE disk found in socket0
Dump CIS Window for Socket #0
  Addr      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  0 2 4 6 8 A C E
--------   -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  ----------------
28000000   01 03 d9 01 ff 1c 04 03 d9 01 ff 18 02 df 01 20  ...............
28000020   04 01 4e 00 01 15 2b 04 01 56 49 4b 49 4e 47 20  ..N...+..VIKING
28000040   43 4f 4d 50 4f 4e 45 4e 54 53 20 20 20 20 20 20  COMPONENTS
28000060   20 20 00 43 46 20 41 54 41 20 00 56 2e 31 30 32  .CF ATA .V.102
28000080   00 ff 21 02 04 01 22 02 01 01 22 03 02 04 5f 1a  ..!..."..."..._.
280000a0   05 01 03 00 02 0f 1b 09 c0 40 a1 21 55 55 08 00  .........@.!UU..
280000c0   22 1b 06 00 01 21 b5 1e 35 1b 0b c1 41 99 21 55  "....!..5...A.!U
280000e0   55 64 f0 ff ff 22 1b 06 01 01 21 b5 1e 35 1b 0d  Ud..."....!..5..
28000100   82 41 98 ea 61 f0 01 07 f6 03 01 ee 22 1b 06 02  .A..a......."...
28000120   01 21 b5 1e 35 1b 0d 83 41 98 ea 61 70 01 07 76  .!..5...A..ap..v
28000140   03 01 ee 22 1b 06 03 01 21 b5 1e 35 14 00 ff ff  ..."....!..5....
28000160   ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  ................
28000180   ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  ................
280001a0   ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  ................
280001c0   ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  ................
280001e0   ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  ................
Dump Config Window for Socket #0
  Addr      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  0 2 4 6 8 A C E
--------   -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  ----------------
28000200   43 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00  C...............
28000220   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ...............
28000240   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000260   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000280   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280002a0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280002c0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280002e0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000300   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000320   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000340   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000360   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
28000380   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280003a0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280003c0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
280003e0   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
```

`pflash` Program Strata Flash

Syntax

```
pflash [options]
```

Options

`-f[=]filename`	input filename
`-eu`	erase used space only (default)
`-ew`	erase whole flash
`-ne`	don't erase flash
`-r`	program resident flash (default)
`-p0`	program PCMCIA slot 0
`-p1`	program PCMCIA slot 1
`-ncis`	don't emit cis for PCMCIA flash cards
`-b[=]addr`	specify base address of flash (hex) for part identification (replaces -r,-p0,-p1)
`-s[=]addr`	specify write/erase address of flash(hex) defaults to base address)
`-u`	leave flash unlocked
`-i`	print out information on flash
`-nv`	don't verify erase or write
`-q`	no progress indicator

Description

The pflash utility allows the programming of Intel Strata Flash parts. The primary use will be in the burning of the OS-9 ROM image into the on-board flash parts at U25/U26. This allows for booting using the lr/bo booters and allows for booting with out a PCMCIA card. The `pflash` utility also can be used to burn OS-9 ROM images into Intel Value Series PCMCIA cards, which internally use StrataFlash parts. This allows for booting using a PCMCIA slot and the f0 booter.

Example

In this example an OS-9 ROM image was built and placed on an ATA PCMCIA card. After booting using the PCMCIA card, the image can be burned into the on-board Flash.

```
$ pflash -f=/mhc1/os9kboot
Unlocking Device
Erasing
Programming
Locking Device
$

<<< Reset the Board via SW1 >>>

OS-9000 Bootstrap for the ARM (Edition 62)

ATA IDE disk found in socket 00
Now trying to Override autobooters.

Press the spacebar for a booter menu


BOOTING PROCEDURES AVAILABLE ---------- <INPUT>

Boot embedded OS-9000 in-place -------- <bo>
Copy embedded OS-9000 to RAM and boot - <lr>
Boot from PCMCIA-0 IDE ---------------- <ide0>
Restart the System -------------------- <q>

Select a boot method from the above menu: lr

Now searching memory ($08000000 - $08ffffff) for an OS-9000
Kernel...

An OS-9000 kernel was found at $08000000
A valid OS-9000 bootfile was found.
$
```

touch_cal Touchscreen Calibration Program

Syntax

```
touch_cal <options>
```

Options

`-f[=]<name>`	Output filename
`-c`	Only run calibration if output filename does not exist
`-m[=]<font_module>`	Use given UCM font module to display text

Description

The `touch_cal` utility will present a text message on the LCD screen as well as points for the user to press. After the points are pressed, the protocol module `mp_ucb1200` will be updated with the new calibration information.

Example

```
$ touch_cal
Found touch screen device '/ucb_touch/mp_ucb1200'
```

ucbtouch

Syntax

```
ucbtouch <>
```

Description

The `ucbtouch` utility prints the raw x,y and pressure values at a set sample rate.

Press the touch screen and observe the output on your console. The utility is helpful in determining whether your touch screen is connected properly.

Example

```
$ ucbtouch
Touch[00000]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=329 Y=322
Touch[00001]: Touch=0x30c3 X1=00329 Y1=00325 P= 28 X=330 Y=326
Touch[00002]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00003]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00004]: Touch=0x30c3 X1=00329 Y1=00319 P= 29 X=330 Y=320
Touch[00005]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00006]: Touch=0x30c3 X1=00329 Y1=00327 P= 28 X=330 Y=328
Touch[00007]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00008]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00009]: Touch=0x30c3 X1=00329 Y1=00322 P= 28 X=330 Y=323
Touch[00010]: Touch=0x30c3 X1=00329 Y1=00319 P= 28 X=0 Y=0
Touch[00011]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=-1 Y=2
Touch[00012]: Touch=0x30c3 X1=00329 Y1=00315 P= 28 X=0 Y=-4
Touch[00013]: Touch=0x30c3 X1=00329 Y1=00322 P= 29 X=0 Y=3
```

Memory Remapping

Note

For this release of Enhanced OS-9 for StrongARM, only the SA-1100 Brutus reference board uses memory remapping. This section does not apply to the default ADS board port.

Edition 4.0 of Enhanced OS-9 for ARM supports the translation of memory from a physical address into a virtual one. This feature makes the ARM SA1100's four DRAM banks appear contiguous, which makes allocating larger amounts of memory possible. This is critical for applications like JAVA. It also enables custom configuration of the memory map for your system. The memory translation table for the system is defined in the following files:

- `$MWOS/OS9000/ARMV4/PORTS/BRUTUS/ROM/ROMCORE/vvectors.a`
- `$MWOS/OS9000/ARMV4/PORTS/BRUTUS/ROM/ROMCORE/virt1100.d`.

When the system comes up, SSM uses this table's information to provide the standard OS-9 per process protection. This translation is possible if the ARM SSM edition #18 or greater is used and the low-level ROM has been compiled to translate memory—which is the default setting.

Note

Translating memory forces devices that need the real physical address of memory (such as DMA) to make the `_os_transadd()` call to convert the virtual address that OS-9 gives them into its physical equivalent. Translation gives rise to the possibility that a memory region, which is given to you by the OS (while being virtual contiguous), may not be physically contiguous. This requires validation of the entire region that is passed to the driver from the OS for physical contiguousness. You must validate the memory region because an external DMA device operates assuming that the address you give it is a physical one and that it is physically contiguous (DMA devices operate outside the MMU).

Below is example C code demonstrating how a simple, fictitious DMA driver might use the `_os_transadd()` call. The ARM SSM will install the `f_transadd` system call, which is accessible though the `_oscall()` mechanism. The `_os_transadd()` C binding in `os_lib.l` currently contains an old and incompatible version, so a temporary version `_os_transadd_t()` is given below.

Sample Code which Utilizes the f_transadd Function

```
#include <types.h>
#include <srvcb.h>
#include <funcs.h>
#include <virtual.h>
#include <sysglob.h>
#include <svctbl.h>
#include <srvcb.h>
#include <funcs.h>
#include <memory.h>
#include <errno.h>

/* _os_transadd_t is used instead of _os_transadd because
   this function has yet to be integrated into Ultra C. An
   older, unused function may be defined which will not work.
   You are encouraged to use the _oscall interface or use
   transadd_t() function below.
 */

error_code _os_transadd_t(u_int32 *, u_int32, void **, void *);
error_code init(void);
error_code term(void);

#define TO_EXTERNAL (0)         /* local->external bus address */
#define TO_LOCAL    (1)         /* external->local bus address */

#define HARDWARE_DEP0 ((u_int32 *) 0xB0000010)
#define HARDWARE_DEP1 ((u_int32 *) 0xB0000014)

u_int32 DMAbase;                /* Physical address */
u_int32 VDMAbase;               /* Virtual address  */
void *Resv;                     /* Reserved field   */

volatile u_int32 *DMAbase_reg1 = HARDWARE_DEP0;      /* DMA base reg */
volatile u_int32 *DMAsize_reg1 = HARDWARE_DEP1;      /* Count size */
u_int32 size;

error_code init()
{
 error_code err;
 u_int32 dmasize;

 size = 0x1000;         /* size of buffer to xfer (4k) */
```

```
/* Allocate memory region which will be used by DMA */
if ((err = _os_srqmem(&size, (void **)&VDMAbase, MEM_ANY)) != SUCCESS)
    return(err);

dmasize = size;         /* Set up to call _os_transadd  */
DMAbase = VDMAbase;     /* Set up to call _os_transadd  */

/* Get physical address for hardware use */
if (!(err = _os_transadd_t(&dmasize, TO_EXTERNAL, (void **)&DMAbase, Resv)))
{
  /* No error, check return variables as needed */
  if ( size != dmasize) /* Is region covered by one translation. */
  {
   /* DMA controllers will not work if the memory transfer block
   * is not physically contiguous. Some error logic needs to be here
   * to parse a possible over-sized request block using loops of the
   * _os_transadd call to find a region which is physically contiguous
   * _or_ to break up the region into multiple DMA transactions
   * (scatter-gather DMA), or to error out (may not be any usable
   * contiguous memory). Since the current translations happen only
   * on 1 Meg boundaries, it is unlikely that your allocation will not
   * be physically contiguous.
   *
   * One way to guarantee that this passes is to assign a separate
   * color node to a region you know to be physically contiguous.
   * See the LCD driver example for the BRUTUS board.
   */
       _os_srtmem(size, &VDMAbase);    /* return memory */
       return(E_IBA);                  /* return error for simple case */
  }
  else  /* The whole region is translated setup up simple controller */
  {
      *DMAbase_reg1 = DMAbase;         /* set base address register */
      *DMAsize_reg1 = dmasize;         /* set up size to transfer   */
        /* .
           .
           .
        */
      return(SUCCESS);         /* It's done, leave */
  }
}
/* _os_transadd returned an error (E_IBA or E_UNKSVC) */
else
{
   /* In this case memory exists but is not being translated, so
   * virtual = physical, and you should use the "virtual" address.
   *
    * To get here, either SSM has not installed f_transadd, so there
   * is NO translating going on, or SSM could not find a matching
   * translation for the address you gave it in the translist. In
   * either case, the system gave you this memory so it is probably
   * good, and NO translation is being done on the region.
    */
```

```
        *DMAbase_reg1 = VDMAbase;   /* set base address register */
        *DMAsize_reg1 = size;       /* set up size to transfer   */
        /*   .
             .
             .
        */
        return(SUCCESS);          /* It’s done, leave */
 }
}

error_code term()
{
  /* To remove the device, remember to use SRTMEM with
   * the "virtual" pointer as this is what the OS uses.
   * It would probably be best to keep these types of
   * pointers in a global area.
   *
   * If you have the need, you can use _os_transadd(.,TO_LOCAL,.,.)
   * to get the virtual address, given a physical address.
   */
}

/* _os_transadd_t - translate an address */
error_code _os_transadd_t(size, mode, blk_addr, reserved)
u_int32             *size;       /* block size to xlate(in), xlate size (out) */
u_int32              mode;        /* direction of translation */
void                 **blk_addr;  /* addr to xlate (in), xlated addr (out) */
void                 *reserved;   /* future use */
{
    register error_code     error;  /* the error code */
    f_transadd_pb           pb;     /* the parameter block */

#if defined(_MPFARM)
    *(int*)(&(pb.cb)) = (1 << 16) | F_TRANSADD;
#else
    pb.cb.code = F_TRANSADD;
    pb.cb.edition = SYSCALL_EDITION;
#endif
    pb.cb.param_size = sizeof(f_transadd_pb);

    pb.size = *size;           /* pass size pointer */
    pb.mode = mode;            /* pass mode */
    pb.blk_addr = *blk_addr;   /* pass addresses pointer */
    pb.reserved = reserved;    /* pass reserved field */
    error = _oscall(&pb);

    *size = pb.size;           /* return size */
    *blk_addr = pb.blk_addr;   /* return xlated adr */
    return error;              /* return error */
}
```

Chapter 3: OS-9 ROM Image Overview

This chapter is an overview of building an Enhanced OS-9 ROM Image and its components. Using the Configuration Wizard eliminates the need to have an in-depth understanding of how to create and update an OS-9 ROM Image. This chapter explains the types of images created by the wizard for those interested in more detailed knowledge.

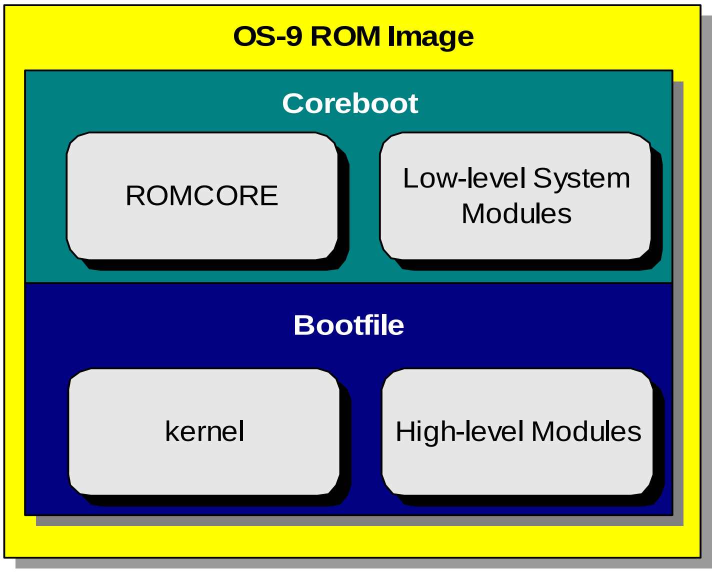
Note

This chapter provides a generic, general overview of the contents of a typical OS-9 ROM image. It is not board/processor specific.

Types of ROM Images

The OS-9 ROM Image is divided into two sets of files to simplify the process of loading and testing OS-9. The low-level images are the coreboot files, which boot the target board to an OS-9 boot menu. The high-level images are the bootfile files, which boot the board up to an OS-9 shell prompt.

Figure 3-1 OS-9 ROM Image



Coreboot Image

Coreboot is the low-level image that boots the system up to the OS-9 boot menu on the target board. Coreboot is the ROMCore image merged with several low-level system modules. From this boot menu you can select a booter module (Flash, PCMCIA ATA card, RAM, etc.). This tells ROMCore the location from which to load the high-level system. At this point, OS-9 is not yet capable of running.

The configuration wizard simplifies the process of building a coreboot image. **Table 3-1** lists the typically included modules. In this case, the high-level system is to be booted from a PCMCIA card:

Table 3-1 Typical Coreboot Image Contents

Name	Description
`bootsys`	Booter registration service module.
`cnfgdata`	Contains the low-level configuration data.
`cnfgfunc`	Provides access services to cnfgdata data.
`commcnfg`	Inits communication port defined in cnfgdata.
`conscnfg`	Inits console port defined in cnfgdata.
`console`	Provides console services.
`dbgentry`	Inits debugger entry point for system use.
`dbgserve`	Provides debugger services.
`dbinit`	Initilizes any daughter boards present.
`excption`	Provides low-level exception services.
`flshcach`	Provides low-level cache management services.
`hlproto`	Provides user level code access to protoman.
`ide`	IDE boot support module. PCMCIA compatible.
`io1100`	Provides polled serial driver support for the low-level system.
`llbootp`	Booter that provides bootp services.

Table 3-1 Typical Coreboot Image Contents (continued)

Name	Description
`llcis`	Inits the PCMCIA interface including cards.
`lle509`	Provides low-level ethernet services via 3COM PCMCIA card.
`llip`	Provides low-level IP services.
`llkermit`	Booter that uses kermit protocol.
`llne2000`	Provides low-level ethernet services via SOCKET-LPE PCMCIA card.
`llslip`	Provides low-level SLIP services.
`lltcp`	Provides low-level TCP services.
`lludp`	Provides low-level UDP services.
`notify`	Provides state change information for use with LL and HL drivers.
`oemglob`	Creates a shared variable area for high/low level system interactions.
`override`	Booter that allows choice between menu and auto booters.
`parser`	Provides argument parsing services.
`pcman`	Booter that reads MS-DOS file system.
`portmenu`	Inits booters defined in the cnfgdata.
`protoman`	Protocol management module.

Table 3-1 Typical Coreboot Image Contents (continued)

Name	Description
`restart`	Booter that cause a soft reboot of system.
`romboot`	Booter that allows booting from ROM.
`rombreak`	Booter that calls the installed debugger.
`rombug`	Low-level system debugger.
`romcore`	Board specific initialization code.
`sndp`	Provides low-level system debug protocol.
`splash`	Provides way to init LCD screen with a compressed image.
`srecord`	Booter that accepts S-Records.
`swtimer`	Provides timer services via software loops.
`tmr1_1100`	Provides low-level timer services via time base register.
`usedebug`	Inits low-level debug interface to RomBug, SNDP, or none.

ROMCore

This is the bootstrap code in raw binary object code. ROMCore exists in the Coreboot image and is responsible for initializing basic hardware, determining boot options, and determining the RAM/ROM configuration. ROMCore calls the system level debugger (if available) as well as the appropriate booter module to find the bootfile. After the high level system is loaded, ROMCore transfers control over to the kernel.

Bootfile Image

This image contains the kernel and other high-level modules (`init` module, file managers, drivers, descriptors, applications). The image is loaded based on the device you select from the boot menu. The bootfile normally brings up a shell prompt, but can be configured to automatically start your application.

The Configuration Wizard simplifies the process of building a Bootfile image. **Table 3-2** lists the typically included high-level modules.

Table 3-2 Typical Bootfile Image Contents

Name	Description
`abort`	P2module that provides a way to enter the system-state debugger.
`cache`	Provides cache control for the CPU cache hardware. The cache module is in the file cach1100.
`fpu`	Provides software emulation for floating point instructions.
`gx_sa1100`	MFM MAUI driver module with support for an LCD panel.
`init`	Descriptor module with high level system initialization information.
`ioman`	Provides generic IO support for all IO device types.
`irq1100`	P2module that provides interrupt acknowledge and dispatching support for the SA1100 pic.
`irq11x1`	P2module that provides interrupt acknowledge and dispatching support for the SA1111 pic (vector range 0x71-0xB2).

Table 3-2 Typical Bootfile Image Contents (continued)

Name	Description
`kernel`	The kernel provides all basic services for the OS-9 system.
`mfm`	Provides generic graphics device support for MAUI.
`nodisk`	Same as init, but used in a disk-less system.
`pcf`	Provides generic block device management functions for MS-DOS FAT format.
`pipe`	Pipeman descriptor that provides a RAM based FIFO that can be used for process communication.
`pipeman`	Provides a memory FIFO buffer for communication.
`pwrman`	P2module that provides generic power management functions.
`pwrplcy`	P2module that provides power state control functions.
`r0`	RBF descriptor that provides access to a ram disk.
`r0.dd`	Same as r0 except with module name dd (for use as the default device).
`ram`	RBF driver that provides a RAM based virtual block device.
`rb1003`	RBF/PCF driver that provides driver support for IDE/EIDE devices. This driver is used to provide disk support for PCMCIA ATA FLASH.

Table 3-2 Typical Bootfile Image Contents (continued)

Name	Description
`rbf`	Provides generic block device management functions for OS-9 specific format.
`rtc1100`	Driver that provides OS-9 access to the SA1110 on-board real time clock.
`sc1100`	SCF driver that provides serial support the SA1110’s SP1 and SP3 ports when configured as UARTS.
`sc16550`	SCF driver that provides serial support for PCMCIA modem cards.
`scf`	Provides generic character device management functions.
`scllio`	SCF driver that provides serial support via the polled low-level serial driver.
`spe509_pcm`	SPF driver to support ethernet for a 3COM EtherLink III PCMCIA card.
`spe91c94`	SPF driver to support ethernet for the SMC91C94 chip.
`spf`	Provides generic protocol device management function support.
`spne2000`	SPF driver to support ethernet for a Socket-LPE CF card.
`spucb1200`	SPF driver that supports the on-board Phillips UCB1200 chip. This device communicates to the SA1100 over SP4 using MCP.

Table 3-2 Typical Bootfile Image Contents (continued)

Name	Description
`ssm`	The System Security Module provides support for the Memory Management Unit (MMU) on the CPU.
`sysif`	P2module that provides SA1100 CPU power state control.
`tk1100`	Driver that provides the system ticker based on the SA1110 Operating System Timer.
`vectors`	Provides interrupt service entry and exit code. The vectors module is found in the file vect110.

Coreboot and Bootfile Image

The combined coreboot and bootfile images are referred to as the OS-9 ROM Image. The OS-9 ROM Image contains a high-level embedded OS-9 bootfile as well as the system bootstrap code, low-level system modules, and embedded utility set for a fully functional OS-9 embedded system.

Boot Menu Options

You select your boot device menu options using the configuration wizard. For each boot device option, you can select whether you want it to be displayed on a boot menu, set up to autoboot, or both. The autoboot option enables the device selected to automatically boot up the high-level bootfile, bypassing the boot device menu.

Note

When using the Configuration Wizard, you should select only one device for autoboot on your system.

Following is an example of the Boot Menu displayed in the terminal emulation window (using `Hyperterminal`):

```
OS-9000 Bootstrap for the ARM

ATA IDE disk found in socket 00
Now trying to Override autobooters.

BOOTING PROCEDURES AVAILABLE ------------- <INPUT>

Boot embedded OS-9000 in-place ----------- <N/A>
Copy embedded OS-9000 to RAM and boot ---- <N/A>
Boot from PCMCIA-1 IDE ------------------- <ide1>
Boot from PCMCIA-0 IDE ------------------- <ide0>
Load bootfile via kermit Download -------- <ker>
Download and Program coreboot into FLASH - <dbc>
Download and Program bootfile into FLASH - <dbb>
Restart the System ----------------------- <q>
Enter system debugger -------------------- <break>

Select a boot method from the above menu: ide0
```

What you select for boot options in the configuration wizard determines what modules are included in the coreboot image. **Table 3-3** lists some of the supported boot devices for Enhanced OS-9:

Table 3-3 Supported Boot Methods

Type of Boot	Description
PCMCIA ATA Card	Copy OS-9 from ATA hard drive to RAM and boot (`ide0`).
Boot embedded OS-9 in-place	Boot OS-9 from FLASH (`bo`)
Copy embedded OS-9 to RAM and Boot	Copy OS-9 from FLASH (if stored there) to RAM and boot (`lr`).

Debuggers

The configuration wizard supports two debuggers, Microware Hawk™ and ROMBug. It installs the appropriate low-level modules in your coreboot file when you make your build. The selection is then contained in the coreboot image that is downloaded to your target system.

Microware Hawk™

Microware Hawk™ and its debugger enable you to create, run, debug, and update your programs. It is included on your Enhanced OS-9 CD.

RomBug

RomBug is used to debug system and user state programs. It runs in supervisor state and takes over control of the CPU when invoked. RomBug is configured as a low-level module that gains access to the resources it needs by using other low-level modules.

Including Options in Your Build

Using the configuration wizard, there are additional options you can select as part of your build. These options enable increased functionality on the target system. Following are descriptions of some of these options.

ROM Utility Set

Table 3-4 lists the utilities in the ROM utility set.

Table 3-4 ROM Utility Set

`shell`	`date`	`devs`	`break`
`deiniz`	`dump`	`echo`	`events`
`exbin`	`help`	`ident`	`iniz`
`irqs`	`link`	`maps`	`mdir`
`mfree`	`printenv`	`procs`	`setime`
`sleep`	`tmode`	`unlink`	`xmode`

For More Information

For more information on ROM utilities, see the ***OS-9 Utilities Reference.***

RomBug in Bootfile (p2init)

The `p2init` utility initializes an `OS9P2` system extension module after the operating system is up and running. This provides additional functionality which would not be available when the `OS9P2` module is initialized as part of the system startup. You can also use the `p2init` utility to add `OS9P2` modules to a running ROM-based system.

User State Debugging Modules

User state is the normal program environment in which processes are executed. Generally, user-state processes do not deal directly with the specific hardware configuration of the system. System-state debugging is defined as debugging the entire system as opposed to just one process running on the system (user-state debugging). System-state debugging is initiated by using the attach command either to attach to a system or to an emulator.

Enable Disk Support Modules

These modules support disk and tape devices in addition to utilities to manipulate these device classes. It adds RBF, PCF, and SCF based I/O devices.

Disk Utilities

These utilities provide utilities for partitioning, formatting, and maintaining disks on target systems.

SoftStax Support Modules

These modules support the SoftStax communications environment on target systems.

NFS Client Support Module

This module provides support for the Network File System (NFS).

Keyboard Support

This enables the use of a keyboard attached to the target system.

Mouse Support

This enables the use of a mouse as an input device on the target system.

User Modules

By default, the only module included is `kermit`. You can include other modules by editing the `user.ml` file under the Sources-Port pull-down menu found in the configuration wizard Advanced Mode.

Appendix A: The Fastboot Enhancement

The Fastboot enhancements to OS-9 provide faster system bootstrap performance to embedded systems. The normal bootstrap performance of OS-9 is attributable to its flexibility. OS-9 handles many different runtime configurations to which it dynamically adjusts during the bootstrap process.

The Fastboot concept consists of informing OS-9 that the defined configuration is static and valid. These assumptions eliminate the dynamic searching OS-9 normally performs during the bootstrap process and enables the system to perform a minimal amount of runtime configuration. As a result, a significant increase in bootstrap speed is achieved.

Overview

The Fastboot enhancement consists of a set of flags that control the bootstrap process. Each flag informs some portion of the bootstrap code that a particular assumption can be made and that the associated bootstrap functionality should be omitted.

The Fastboot enhancement enables control flags to be statically defined when the embedded system is initially configured as well as dynamically altered during the bootstrap process itself. For example, the bootstrap code could be configured to query dip switch settings, respond to device interrupts, or respond to the presence of specific resources which would indicate different bootstrap requirements.

In addition, the Fastboot enhancement’s versatility allows for special considerations under certain circumstances. This versatility is useful in a system where all resources are known, static, and functional, but additional validation is required during bootstrap for a particular instance such as a resource failure. The low-level bootstrap code could respond to some form of user input that would inform it that additional checking and system verification is desired.

Implementation Overview

The Fastboot configuration flags have been implemented as a set of bit fields. An entire 32-bit field has been dedicated for bootstrap configuration. This four-byte field is contained within the set of data structures shared by the ModRom sub-components and the kernel. Hence, the field is available for modification and inspection by the entire set of system modules (high-level and low-level). Currently, there are just six bit flags defined with eight bits reserved for user-definable bootstrap functionality. The reserved user-definable bits are the high-order eight bits (31-24). This leaves bits available for future enhancements. The currently defined bits and their associated bootstrap functionality are listed below:

B_QUICKVAL

The `B_QUICKVAL` bit indicates that only the module headers of modules in ROM are to be validated during the memory module search phase. This causes the CRC check on modules to be omitted. This option is potentially a large time saver due to the complexity and expense of CRC generation. If a system has many modules in ROM, where access time is typically longer than RAM, omitting the CRC check on the modules will drastically decrease the bootstrap time. It is fairly rare that corruption of data occurs in ROM. Therefore, omitting CRC checking will usually be a safe option.

B_OKRAM

The `B_OKRAM` bit informs both the low-level and high-level systems that they should accept their respective RAM definitions without verification. Normally, the system probes memory during bootstrap based on the defined RAM parameters. This allows system designers to specify a possible RAM range which the system will validate upon startup. Thus the system can accommodate varying amounts of RAM. But in an embedded system where the RAM limits are usually statically defined and presumed to be functional, there is no need to validate the defined RAM list. Bootstrap time is saved by assuming that the RAM definition is accurate.

B_OKROM

The `B_OKROM` bit causes acceptance of the ROM definition without probing for ROM. This configuration option behaves just like the `B_OKRAM` option except that it applies to the acceptance of the ROM definition.

B_1STINIT

The `B_1STINIT` bit causes acceptance of the first `init` module found during cold-start. By default, the kernel searches the entire ROM list passed up by the `ModRom` for `init` modules before it accepts and uses the `init` module with the highest revision number. In a statically defined system, time is saved by using this option to omit the extended `init` module search.

B_NOIRQMASK

The `B_NOIRQMASK` bit informs the entire bootstrap system that it should not mask interrupts for the duration of the bootstrap process. Normally, the `ModRom` code and the kernel cold-start mask interrupts for the duration of the system startup. But some systems that have a well defined interrupt system (i.e. completely calmed by the `sysinit` hardware initialization code) and also have a requirement to respond to an installed interrupt handler during system startup can enable this option to prevent the ModRom and the kernel cold-start from disabling interrupts. This is particularly useful in power-sensitive systems that need to respond to “power-failure” oriented interrupts.

Note

Some portions of the system may still mask interrupts for short periods during the execution of critical sections.

B_NOPARITY

If the RAM probing operation has not been omitted, the `B_NOPARITY` bit causes the system to not perform parity initialization of the RAM. Parity initialization occurs during the RAM probe phase. The `B_NOPARITY` option is useful for systems that either require no parity initialization at all or systems that only require it for “power-on” reset conditions. Systems that only require parity initialization for initial “power-on” reset conditions can dynamically use this option to prevent parity initialization for subsequent “non-power-on” reset conditions.

Implementation Details

This section describes the compile-time and runtime methods by which users can control the bootstrap speed of their system.

Compile-time Configuration

The compile-time configuration of the bootstrap is provided by a pre-defined macro (`BOOT_CONFIG`) which is used to set the initial bit-field values of the bootstrap flags. Users can redefine the macro for recompilation to create a new bootstrap configuration. The new over-riding value of the macro should be established by redefining the macro in the `rom_config.h` header file or as a macro definition parameter in the compilation command.

The `rom_config.h` header file is one of the main files used to configure the ModRom system. It contains many of the specific configuration details of the low-level system. Here is an example of how a user can redefine the bootstrap configuration of their system using the `BOOT_CONFIG` macro in the `rom_config.h` header file:

```
#define BOOT_CONFIG (B_OKRAM + B_OKROM + B_QUICKVAL)
```

And here is an alternate example showing the default definition as a compile switch in the compilation command in the makefile:

```
SPEC_COPTS = -dNEWINFO –dNOPARITYINIT –dBOOT_CONFIG=0x7
```

This redefinition of the `BOOT_CONFIG` macro would result in a bootstrap method which would accept the RAM and ROM definitions as they are without verification, and also validate modules solely on the correctness of their module headers.

Runtime Configuration

The default bootstrap configuration can be overridden at runtime by changing the `rinf->os->boot_config` variable from either a low-level P2 module or from the `sysinit2()` function of the sysinit.c file. The runtime code can query jumper or other hardware settings to determine what user-defined bootstrap procedure should be used. An example P2 module is shown below.

Note

If the override is performed in the sysinit2() function, the effect is not realized until after the low-level system memory searches have been performed. This means that any runtime override of the default settings pertaining to the memory search must be done from the code in the P2 module code.

```
#define NEWINFO
#include <rom.h>
#include <types.h>
#include <const.h>
#include <errno.h>
#include <romerrno.h>
#include <p2lib.h>

error_code p2start(Rominfo rinf, u_char *glbls)
{
   /* if switch or jumper setting is set… */
   if (switch_or_jumper == SET) {
      /* force checking of ROM and RAM lists */
      rinf->os->boot_config &= ~(B_OKROM+B_OKRAM);
   }
   return SUCCESS;
}
```

Appendix B: MAUI Driver Descriptions

This chapter provides MAUI driver descriptions. It includes the following sections:

GraphicsClient Objects

This package provides object-level support for the Intel GraphicsClient reference board. The port directory is at the following location:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSCLIENT`

MAUI objects

`cdb`	Lists the devices on the system.
`mp_msptr`	Serial mouse protocol module.
`mp_ucb1200`	Touch screen protocol module for the UCB1200.
`gfx` and `gx_sa1100`	LCD graphics descriptor and driver.

GX_SA1100 LCD Graphic Driver Specification

This section describes the hardware specification of the StrongARM SA1100 LCD driver (named gx_sa1100) and descriptor (named gfx). The hardware sub-type defines the board configuration. This specification should be used with the MAUI Graphics Device API.

Board Ports

This driver is used in two of the three example board StrongArm ports.

The Brutus board uses a Kyocera KCS057QV1AA-G03 (formerly KCS3224ASTT-X1), 8 bpp Color, STN, with a resolution of 320x480 single panel.

The GraphicsClient board uses a Sharp LQ64D341 18 bpp color (16 used), TFT, with a resolution of 640x480 single panel. This panel is connected to the GraphicsClient with one of several possible cables:

- 8 bpp - most common to date
- RGB 565 - next most common
- RGB 655
- RGB 556

The SideArm board can support an LCD panel, but does not typically ship with one. For this reason the SideArm port does not build this driver. If the user did connect a LCD panel to this board, simply copy the makefiles from one of the other ports into the SideArm port.

Device Capabilities

Information about the hardware capabilities is determined by calling `gfx_get_dev_cap()`. The hardware sub-type defines the board configuration. This function returns a data structure formatted as shown in Table B-1. See `GFX_DEV_CAP` for more information about this data structure.

Table B-1 gfx_get_dev_cap() Data Structure

Member Name	Description	Value
`hw_type`	Hardware type (embedded in driver)	SA1100 LCD Controller
`hw_subtype`	Hardware subtype (embedded in descriptor)	Brutus 8 bit color LCD, Graphicsclient 8 bit color LCD, or GraphicsClient 16 bit color LCD
`sup_vpmix`	Supports viewport mixing	FALSE
`sup_extvid`	Supports external video as a backup	FALSE
`sup_bkcol`	Supports background color	FALSE
`sup_vptrans`	Supports viewport transparency	FALSE
`sup_vpinten`	Supports viewport intensity	FALSE
`sup_sync`	Supports retrace synchronization	FALSE

Table B-1 gfx_get_dev_cap() Data Structure (continued)

Member Name	Description	Value
`num_res`	Number of display resolutions	1
`res_info`	Array of display resolution information	See Display Resolution table
`dac_depth`	Depth of the DAC in bits	12
`num_cm`	Number of coding methods	1
`cm_info`	Array of coding method information	See Coding Methods table
`sup_viddecode`	Supports video decoding into a drawmap	FALSE

Display Resolution

The display resolution is configured by the descriptor and can be changed to support LCD panels of different sizes. The driver is only designed to support one resolution at a time. That resolution is specified by the descriptor. Modify the `DEFAULT_RES` macro in `mfm_desc.h` to change the resolution. If you change the resolution, you must also change all of the LCD timing fields as well.

Table B-2 Display Specifications

Board	Width	Height	Refresh Rate	Interlace Mode	Aspect Ratio X:Y
Brutus	320	240	0*	`GFX_INTL_OFF`	1:1
Graphics-Client	640	480	0*	`GFX_INTL_OFF`	1:1

*Refresh rate is determined by timing specified in descriptor. The devcap is not automatically update to reflect this.

Coding Methods

The coding method is also configured by the descriptor and can be changed to support b/w and color LCD panels. The coding method can be selected in the descriptor by simply specifying the coding method in the `DEFAULT_CM` macro in `mfm_desc.h`.

This driver was verified on the Brutus evaluation board with an 8-bit cable, and a GraphicsClient with both a 8-bit and 565 cables. The maximal coding method supported by SA1100 LCD Controller is 16 bpp.

Table B-3 Coding Method Description

Board	Coding Method	CLUT Based	X,Y Multipliers	Palette Color Types
Brutus, and Graphics-Client w/8 bit cable	`GFX_CM_8BIT`	TRUE	1,1	GFX_COLOR_RGB
Graphics-Client w/16 bit cable	`GFX_CM_565`, `GFX_CM_655`, or `GFX_CM_556`	FALSE	1,1	NA
No current hardware implementati on available	`GFX_CM_4BIT`	TRUE	1,1	GFX_COLOR_RGB

Viewport Complexity

The driver supports one active viewport at a time. The application can create multiple viewports and stack them. The viewport must be aligned with, and the same size as the display. Display drawmaps must be the same size as the viewport.

Memory

Applications are expected to request graphics memory from the driver. The driver allocates memory from the system as needed. It requests this memory from color 0x80. This memory (specified in the init module) is located at the bottom of 16 MB DRAM address space and is marked as non cached.

Location

This driver's source is located in:

`SRC/DPIO/MFM/DRVR/GX_SA1100`

This driver's makefiles are located in:

`OS9000/ARMV4/PORTS/BRUTUS/MAUI/GX_SA1100`, and

`OS9000/ARMV4/PORTS/GRAPHICSCLIENT/MAUI/GX_SA1100`

This directory contains the makefiles and descriptor header file to build the descriptor(s) and driver(s) (not all packages include driver source) for the StrongARM reference platform. This directory contains:

`makefile`	Calls each of the other makefiles in this directory
`drvr.mak`	Builds the driver
`desc.mak`	Builds the descriptor(s)
`mfm_desc.h`	Defines values for all modifiable fields of the descriptor(s)

Build the Driver

The driver source is located in `SRC/DPIO/MFM/DRVR/GX_SA1100`. To build the driver, use the following commands:

```
cd OS9000/ARMV4/PORTS/BRUTUS/MAUI/GX_SA1100
os9make -f drvr.mak
```

Build the Descriptor

To build a new descriptor, modify `mfm_desc.h`, and use the following commands to compile:

`cd OS9000/ARMV4/PORTS/BRUTUS/MAUI/GX_SA1100`, or

`OS9000/ARMV4/PORTS/GRAPHICSCLIENT/MAUI/GX_SA1100`

`os9make -f desc.mak`

To build both the driver and the descriptor you can specify `os9make` with no parameters.

GX_SA1101 VGA Graphic Driver Specification

This section describes the hardware specification of the StrongARM/SideKick SA1101 VGA driver (`gx_sa1101`) and descriptor (`vga`). The hardware sub-type defines the board configuration. This specification should be used with the MAUI Graphics Device API.

Device Capabilities

Information about the hardware capabilities is determined by calling `gfx_get_dev_cap()`. The hardware sub-type defines the board configuration. This function returns a data structure formatted as shown in **Table B-4**. See `GFX_DEV_CAP` for more information about this data structure.

Table B-4 gfx_get_dev_cap() Data Structure

Member Name	Description	Value
`hw_type`	Hardware type (embedded in driver)	SA1101 VGA Controller
`hw_subtype`	Hardware subtype (embedded in descriptor)	Sidekick VGA Controller w/ IOBLT
`sup_vpmix`	Supports viewport mixing	FALSE
`sup_extvid`	Supports external video as a backup	FALSE
`sup_bkcol`	Supports background color	TRUE
`sup_vptrans`	Supports viewport transparency	FALSE

Table B-4 gfx_get_dev_cap() Data Structure (continued)

Member Name	Description	Value
`sup_vpinten`	Supports viewport intensity	FALSE
`sup_sync`	Supports retrace synchronization	TRUE
`num_res`	Number of display resolutions	3
`res_info`	Array of display resolution information	See Display Resolution table
`dac_depth`	Depth of the DAC in bits	12
`num_cm`	Number of coding methods	1
`cm_info`	Array of coding method information	See Coding Methods table
`sup_viddecode`	Supports video decoding into a drawmap	FALSE

Display Resolution

The display resolution is configured by the descriptor and can be changed to support LCD panels of different sizes. The driver is only designed to support one resolution at a time. That resolution is specified by the descriptor. Modify the DEFAULT_RES macro in mfm_desc.h to change the resolution. If you change the resolution, you must also change all of the LCD timing fields as well.

Table B-5 Display Specifications

Width	Height	Refresh Rate	Interlace Mode	Aspect Ratio X:Y
640	480	72.8	GFX_INTL_OFF	1:1
800*	600	72.8	GFX_INTL_OFF	1:1
1024*	768	70.4	GFX_INTL_OFF	1:1

*Dedicated memory mode only

Coding Methods

The coding method is also configured by the descriptor and can be changed to support b/w and color LCD panels. The coding method can be selected in the descriptor by simply specifying the coding method in the DEFAULT_CM macro in mfm_desc.h.

This driver was verified on the Brutus evaluation board with an 8-bit cable, and a GraphicsClient with both a 8-bit and 565 cables. The maximal coding method supported by SA1100 LCD Controller is 16 bpp.

Table B-6 Coding Method Description

Coding Method	CLUT Based	X,Y Multipliers	Palette Color Types
GFX_CM_8BIT	TRUE	1,1	GFX_COLOR_RGB

Viewport Complexity

The driver supports one active viewport at a time. The application can create multiple viewports and stack them. The viewport must be aligned with, and the same size as the display. Display drawmaps must be the same size as the viewport.

Memory

Applications are expected to request graphics memory from the driver. The driver allocates memory from the system as needed. It requests this memory from color 0x80. This memory (specified in the init module) is located at the high end of the 16/32 MB DRAM address space and is marked as non cached.

The driver can operate in either unified or dedicated mode. On the development SideArm/SideKick board we recommend against the unified mode because the system does not have the memory bandwidth to adequately display even 640x480. In dedicated mode we had to implement significant work arounds to

Location

This driver's source is located in:

`SRC/DPIO/MFM/DRVR/GX_SA1101`

This driver's makefiles are located in:

`OS9000/ARMV4/PORTS/SIDEARM/MAUI/GX_SA1101`

This directory contains the makefiles and descriptor header file to build the descriptor(s) and driver(s) (not all packages include driver source) for the StrongARM reference platform. This directory contains:

`makefile`	Calls each of the other makefiles in this directory
`drvr.mak`	Builds the driver
`desc.mak`	Builds the descriptor(s)
`mfm_desc.h`	Defines values for all modifiable fields of the descriptor(s)

Build the Driver

The driver source is located in `SRC/DPIO/MFM/DRVR/GX_SA1101`. To build the driver, use the following commands:

```
cd OS9000/ARMV4/PORTS/SIDEARM/MAUI/GX_SA1101
os9make -f drvr.mak
```

Build the Descriptor

To build a new descriptor, modify `mfm_desc.h`, and use the following commands to compile:

```
cd OS9000/ARMV4/PORTS/SIDEARM/MAUI/GX_SA1101
os9make -f desc.mak
```

To build both the driver and the descriptor you can specify `os9make` with no parameters.

SD_UCB1200 Sound Driver Specification

This section describes the hardware specifications for the Philips UCB1200 driver sd_ucb1200. The hardware sub-type defines the board configuration. This specification should be used in conjunction with the MAUI Sound Driver Interface.

This driver works in conjunction with the spucb1200 driver.

Device Capabilities

Information about the hardware capabilities is determined by calling _os_gs_snd_devcap(). This function returns a data structure formatted as in the following table. See SND_DEV_CAP for more information about this data structure.

Table B-7 Data Returned in SND_DEV_CAP

Member Name	Value	Description
hw_type	CS4231	Hardware type
hw_subtype	CS4231A	Hardware sub-type
sup_triggers	SND_TRIG_ANY	Supported triggers
play_lines	SND_LINE_SPEAKER	Play gain/mix lines
record_lines	SND_LINE_MIC	Record gain/mix lines
sup_gain_cmds	SND_GAIN_CMD_MONO	Mask of supported gain commands
num_gain_caps	2	Number of SND_GAIN_CAPs

Table B-7 Data Returned in SND_DEV_CAP (continued)

Member Name	Value	Description
`gain_caps`	See Gain Capabilities Array	Pointer to `SND_GAIN_CAP` array
`num_rates`	30	Number of sample rates
`sample_rates`	See Sample Rates	Pointer to sample rate array
`num_chan_info`	1	Number of channel info entries
`channel_info`	See Number of Channels	Pointer to channel info array
`num_cm`	3	Number of coding methods
`cm_info`	See Encoding and Decoding Formats	Pointer to coding method array

Gain Capabilities Array

The following tables show the various gain capabilities for the Philips UCB1200. This information is pointed to by the gain_cap member of the SND_DEV_CAP data structure. See SND_GAIN_CAP for more information about this data structure. This driver allows control of following individual physical gain controls:

Table B-8 Individual Gain Controls

`SND LINE SPEAKER`	Output Attenuation
`SND LINE MIC`	Microphone Gain

The following tables detail the various individual gain capabilities:

Table B-9 Speaker Gain Enable

Member Name	Value	Step	HW	Level	Comments
lines	`SND_LINE_SPEAKER`	0-3	31	-69 dB	default_level
`sup_mute`	`TRUE`	4-7	30	-66.8 dB	
`default_type`	`SND_GAIN_CMD_MONO`	8-11	29	-64.7 dB	
`default_level`	`SND_LEVEL_MAX`	12-15	28	-62.5 dB	
`zero_level`	`SND_LEVEL_MIN`	...	...	...	
`num_steps`	`32`	112-115	3	-6.5 dB	
`step_size`	`216`	116-119	2	-4.3 dB	
mindb	`-6900`	120-123	1	-2.2 dB	
maxdb	`0`	124-127	0	0.0 dB	zero_level

Table B-10 Mic Gain Enable

Member Name	Value	Step	HW	Level	Comments
lines	SND_LINE_MIC	0-3	0	0 dB	zero_level
sup_mute	FALSE	4-7	1	0.7 dB	
default_type	SND_GAIN_CMD_MONO	...	...	...	...
default_level	SND_LEVEL_MAX	64-67	16	11.3 dB	default_level
zero_level	SND_LEVEL_MIN	...	...	...	...
num_steps	32	112-115		20.4 dB	
step_size	70	116-119	29	21.1 dB	
mindb	0	120-123	30	21.8 dB	
maxdb	2250	124-127	31	22.5 dB	

Sample Rates

Following is an abbreviated list of the supported sample rates for the UCB1200. Below is a formula to derive valid sample rates:

sample_rate = 11981000/(32 * i), where 8 < i < 128

This information is pointed to by the `sample_rates` member of the `SND_DEV_CAP` data structure.

Table B-11 Sample Rate (Hz)

2948	3941	4926	5942	6933
7966	8914	9852	10697	11700
12910	13866	14976	15600	17828
18720	19705	20800	22023	23400
24960	26743	28800	31200	34036
37440	41600	46801	53486	62401

Number of Channels

The following table shows the different supported number of channels for the Philips UCB1200. The first entry in the table is the default number of channels. This information is pointed to by the `channel_info` member of the `SND_DEV_CAP` data structure.

Table B-12 Number of Channels

Channels	Description
1	Mono

Encoding and Decoding Formats

The following table shows the supported encoding and decoding formats for the Philips UCB1200. The first entry in the table is the default format. This information is pointed to by the `cm_info` member of the `SND_DEV_CAP` data structure.

Table B-13 Encoding and Decoding Formats

Coding Method	Sample Size	Boundary Size	Description
`SND_CM_PCM_ULAW`	8	2	8 bit u-Law commanded
`SND_CM_PCM_SLINEAR SND_CM_LSBYTE1ST`	16	4	16 bit Linear (two's complement) little endian
`SND_CM_PCM_SLINEAR`	16	4	16 bit Linear signed (two's complement) big endian

SPUCB1200 driver for the UCB1200 Codec

This document describes the hardware specifications for the Philips UCB1200 driver. This is an SPF driver.

Capabilities

The UCB1200 is capable of controlling a microphone/speaker, input/output telecommunications lines, resistive style touch screen, and 16 General Purpose Input/Output lines. This driver currently can only control the touch screen, and general purpose input/output lines. The microphone/speaker can be controlled with a MAUI Sound driver called `sd_ucb1200`. No driver has been written for the telecommunications part of the UCB1200.

Descriptors

Table B-14 lists the UCB1200 descriptors.

Table B-14

Name	Function
`ucb`	UCB1200 Chip Initialization
`ucb_audio`	Not Implemented
`ucb_touch`	Touch Screen
`ucb_gpio`	Control GPIO Lines
`ucb_telecom`	Not Implemented

UCB

Opening the /ucb device will perform basic chip initialization. Normally this is not necessary, unless another driver is written to control part of the UCB1200 functions. This is the case for audio. The MAUI Sound driver `sd_ucb1200` will open /ucb to perform chip initialization. In this way, the MAUI Sound driver play audio and this driver can control the touch screen at the same time.

Audio

This portion of the driver is not implemented since the MAUI Sound driver `sd_ucb1200` already exists. `sd_ucb1200` and this driver can co-exist.

Touch Screen

This portion of the driver controls the touch screen operation. When pressure is applied to the touch screen, a hardware interrupt is raised, and this driver's interrupt service routine will execute. A system state alarm, then, will fire at regular intervals to sample data from the touch screen. When pressure is removed, the alarm stops. This mechanism leaves the UCB1200 in a low power state until the user presses the touch screen. The alarm rate can be controlled in the `ucb_touch` descriptor.

Each sample contains an x, y coordinate as well as pressure information. The data is formatted into a six byte packet as defined in the table below. Each packet contains 10 bits of x, 10 bits of y, and 8 bits of pressure information.

Table B-15 Touch Screen Descriptor Data

Byte number	Description
0	sync code - 0x80
1	header: bit 1: pendown bit 2: penup bit 3: penmove (may occur with pendown or penup)
2	bits 0..2: high 3 bits of x bits 3..6: high 4 bits of pressure bit 7: 0
3	bits 0..6: low 7 bits of x bit 7: 0
4	bits 0..2: high 3 bits of y bits 3..6: low 4 bits of pressure
5	bits 0..6: low bits of y bit 7: 0

GPIO

This section of the driver has basic GPIO line control, where lines 0..9 are connected to a 7 segment display or LED. Each line can be controlled with an `_os_write()` call. (Refer to the UCBHEX program in the TEST directory.)

Telecom

This portion of the driver is not implemented.

Supporting Modules

Before this driver can be used, the following modules must be in memory: `spf`, `sysmbuf`, `mbinstall`. `mbinstall` must also be run before use.

MP_UCB1200 MAUI Touch screen Protocol Module

This document describes the function of the `mp_ucb1200` protocol module, as well as a high level discussion of the touch screen driver and calibration application.

Overview

The protocol module converts the driver raw data into a `MAUI_MSG` structure. In this way, applications can remain somewhat ignorant of the details of the hardware since it deals with the MAUI Input layer. In this protocol module, the raw hardware data is converted into screen coordinates. In addition, some data filtering occurs to reduce the amount of erroneous data that the touch screen hardware can produce.

Data Format

The touch screen driver sends a 6 byte packet that contains x, y, and pressure information. The exact format of this packet is described in the spucb1200 driver.

Data Filter

This protocol module filters the data coming from the hardware in an attempt to reduce erroneous data. Two methods are implemented: data point averaging and low pressure point removal. The first method will average the last two points received from the driver. The data point will lag slightly behind the current position, then, but the average will reduce erroneous data points produced by the hardware. The second method throw out data points where the pressure below a certain threshold. It seems that extremely light touches will cause the data to become erratic, although the exact pressure threshold is hardware dependent.

Raw Mode

An application can put this protocol module in a "raw" mode where data points are not filtered, averaged, or converted to screen coordinates. That is, the data from the hardware is passed directly up to the application.

The application can put this protocol module in a "raw" mode by calling: `inp_set_sim_meth(inpdev,RAW_MODE)`. After calibration, the program will need to put the protocol module back in NATIVE mode by calling: `inp_set_sim_meth(inpdev,DEFAULT_SIM_METH)`. There is a sample touch screen Calibration Application in the `TOUCH_CAL` directory.

When the protocol module is taken out of "raw" mode, it will try to read new calibration data points from the ucb1200.dat data module. After the data is read from the module, it is no longer needed.

cdb.touch

The touch screen can be registered with MAUI by loading the `cdb.touch` module in memory before any programs using input are started. This will specify the spucb1200 as the driver, `cdb.touch` as the descriptor, and `mp_ucb1200` as the protocol module.

Compile Time Options

Table B-16 shows compile time options used to control the default calibration settings and also the screen size. These options can be specified with a value in the `mp_ucb1200` makefile to modify the defaults.

Table B-16 Compile Time Options

Name	Purpose
`SCREEN_WIDTH`	Screen Width in Pixels
`SCREEN_HEIGHT`	Screen Weight in Pixels
`DEFAULT_CALIBRATION_X`	Left Calibration Hardware Point
`DEFAULT_CALIBRATION_Y`	Top Calibration Hardware Point
`DEFAULT_CALIBRATION_WIDTH`	Width of Screen In Hardware Points
`DEFAULT_CALIBRATION_HEIGHT`	Height of Screen In Hardware Points
`JITTER_THRESHOLD`	Minimum Pixel Change Required Before Points are Reported to the Application.
`NUM_PTS`	This allows you to choose how many successive data points to average in order to produce less erroneous screen coordinate data to the application. The default is 2, and valid choices are 1, 2, 4, 8, 16.
`MIN_PRESSURE`	Any pressure point less than this value will be ignored. This is another way to reduce erroneous data. This represents the 8 bit pressure value we get from the driver. The default is 40.

Calibration Application

There is a sample calibration application located in the `$(MWOS)/SRC/MAUI/MP/MP_UCB1200/TOUCH_CAL` directory. This application, called `touch_cal`, will present a text message on the screen as well as points for the user to press. After the points are pressed, the protocol module `mp_ucb1200` will be updated with the new calibration information.

Assumptions/Dependencies

1. A Window Manager must be running before this application will operate.
2. A font module must be present to run the demo. `default.fnt` is the default module, or you can specify one on the command line.
3. `touch_cal` will open the first `CDB_TYPE_REMOTE` device in the cdb.

Command Line Options

`-f[=]<outfile>`	Specifies the filename of the calibration information module. This program will write the calibration information to this filename if it is specified. The file contains the calibration information as a data module, thus allowing the information to be stored on disk, nv RAM, flash, etc. for use the next time the hardware is rebooted.
`-c`	This option only works if `-f` is specified. This will cause the calibration program to run only if the filename specified with `-f` is not present.
`-m=<font module>`	Specifies the font module to use for displaying the text message on the screen.

Coordination with Protocol Module

The protocol module `mp_ucb1200` and the touch screen application `touch_cal` work together to provide the calibration functionality. `touch_cal` must first open the touch screen device, and then must set it into Raw Mode. After the user selects each calibration point, `touch_cal` computes the average of them. These averaged hardware points (as well as the screen resolution) are then stored in a data module called `ucb1200.dat.` When the input device is taken out of Raw Mode, the protocol module will link to `ucb1200.dat` and update itself with the new calibration information.

Compiling

The makefile for touch_cal exists in the `$(PORTS)//MAUI/MP_UCB1200/TOUCH_CAL` directory.

Product Discrepancy Report

To: Microware Customer Support

FAX: 515-224-1352

From:____

Company:____

Phone:____

Fax:______________________Email:___________________

Product Name:

Description of Problem:

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Host Platform_______________________________________

Target Platform_____________________________________

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